

Spot Safety Project Evaluation

Project Log # 200501214

Spot Safety Project # 14-97-018

**Spot Safety Project Evaluation of the Directional Crossover Installations on US 23 / 74
Located From the Jackson County Line to East of SR 1158 in Haywood County**

Documents Prepared By:

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9/16/05
Date

Spot Safety Project Evaluation Documentation

Subject Location

Evaluation of Spot Safety Project Number 14-97-018 –
The Directional Crossovers on US 23/ 74 in Haywood County,
Located from the Jackson County Line (MP 0.0) to east of SR 1158 (MP 2.07).

The strip on US 23/ 74 contains the following crossovers*:

- Location 1: Blue Ridge Parkway Entrance
Three-Leg Full Movement, Located at MP 0.2
- Location 2: SR 1156 (Timberlake Road)
Four-Leg Full Movement, Located at MP 0.54
- Location 3: Motel PVA
Three-Leg Full Movement, Located at MP 0.75
- Location 4: Balsam Rest Area
Three-Leg Directional, Located at MP 0.99
- Location 5: SR 1155 (Red Banks Road) / SR 1157 (Walker Road)
Four-Leg Directional, Located at MP 1.11
- Location 6: Non Intersection U-Turn With Bulb-Out
MP 1.35
- Location 7: Barber Hill Road / Seminole Road
Four-Leg Directional, Located at MP 1.45
- Location 8: SR 1158/ SR 1243 (Old Balsam Road)
Four-Leg Directional, Located at MP 1.69
- Location 9: Non Intersection U-Turn With Bulb-Out
MP 2.07

*Please see the attached *Location Maps* for further detail.

Introduction

In an attempt to assess the safety of our roads, the Safety Evaluation Group of the Traffic Safety Systems Management Section has evaluated the above project. The methodologies used in this evaluation offer various philosophies and ideas, in an effort to provide objective countermeasure crash reduction results. A naive before and after analysis has been completed to measure the effectiveness of the spot safety improvement. This information is provided to you so the benefit or lack of benefit for this type of project can be recognized and utilized for future projects.

Project Information and Background from the Project File Folder

The spot safety project improvement countermeasure chosen for the subject locations was the modification of several existing median crossovers to provide channelization that prohibits left turns and crossing movements from the side streets. In addition, two new crossovers with “jughandles” (Locations 6 and 9) were constructed to accommodate U-turns and left-turns denied at the directional crossovers.

The intersections that received channelizing improvements included:

- Location 4 (installed poles to prevent left-turn movements from the Rest Area),
- Location 5 (installed raised pavement island and poles to prevent left-turn and through movements from the side street and left-turn movements from eastbound US 23/ 74 traffic),
- Location 7 (installed raised pavement island and poles to prevent left-turn and through movements from the side street), and
- Location 8 (installed raised pavement island and poles to prevent left-turn and through movements from the side street).

A local citizen originally requested the improvements. US 23/ 74 is a four-lane divided roadway with two travel lanes in each direction and has a speed limit of 55 mph within the vicinity of the treatment locations. All side streets are two-lane roadways under stop (or yield) sign control. This section of US 23/74 has experienced urban growth and commercial development that wasn't intended to be served by this type of facility.

The initial crash analyses was completed for the 1.7-mile strip on US 23/ 74 from the Jackson County Line east to SR 1158. The initial study time period was from January 1, 1995 through December 31, 1997. According to the initial analysis, there were twenty-five Angle Crashes (including two fatalities) clustered at Locations 4, 5, and 8. The primary focus of this evaluation will therefore fall on Locations 4, 5, and 8. As stated above, Location 7 also received channelizing improvements but did not display a strong crash pattern in the initial spot safety project. The treatment was installed as an attempt to solve the crash problem at Locations 4, 5, and 8 without installing traffic signals on US 23/ 74. Please note that the initial crash analysis used to justify the improvements differs from the crash analysis used in this evaluation. The final completion date for the improvements at the subject intersections was on February 1, 2001.

Naïve Before and After Analysis

After reviewing the spot safety project file folder along with all the crashes at the subject locations, the crash data omitted from this analysis to consider for an adequate construction period was from February 1, 2000 through January 31, 2002. The before period consisted of reported crashes from February 1, 1997 through January 31, 2000 (3 Years) and the after period consisted of reported crashes from February 1, 2002 through January 31, 2005 (3 Years). The ending date for this analysis was determined by the available crash data at the time the crash analysis was completed.

The treatment data consists of crashes located within 150 feet from each location. The section on US 23/ 74 that was additionally analyzed is from the Jackson County Line (MP 0.0) east to the crossover at Location 9 (MP 2.07). Naïve before and after analyses were performed at all locations in order to test for crash migration.

Table 1 depicts the Naïve Before and After Analysis for Locations 1 through 9, which includes the directional crossovers, the crossovers constructed for U-turns, and the crossovers influenced by the directional crossovers. In addition, the Naïve Before and After Analysis for the section of US 23/ 74 within the treatment influence area is also provided. Please note that Frontal Impact Crashes were the target crashes for the applied countermeasure. The Frontal Impact Crash types considered are as follows: Left turn, same roadway; Left turn, different roadways; Right turn, same roadway; Right turn, different roadways; Head on; and Angle. The before period ADT year was 1998, and the after period ADT year was 2003.

Table 1. Crash Breakdown by Location

Median Crossovers Summary	Before	After	Percent Reduction (-)/ Percent Increase (+)
Location 1	0	2	n/a
Location 2	1	2	100.0
Location 3	0	2	n/a
Location 4	10	12	20.0
Location 5	9	3	-66.7
Location 6	0	1	n/a
Location 7	1	1	0.0
Location 8	14	8	-42.9
Location 9	0	1	n/a
Total Crossover Crashes	35	32	-8.6
US 23/74 Section	51	50	-2.0
US 23/74 Section ADT	18000	19000	5.6

Table 2 contains the Crash Summary for the US 23/ 74 Section. Table 3 contains the Crash Summary for Locations 4, 5, and 8. The Severity Index for Total and Frontal Impact Crashes and an Injury Summary are provided in both tables. A Crash Type Summary for the Section is also provided in Table 2.

Table 2. US 23/ 74 Section (MP 0.0 to MP 2.07) Crash Summary

US 23/74 Section Summary	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes	51	50	-2.0
Total Severity Index	21.74	11.54	-46.9
Frontal Impact Crashes	28	7	-75.0
Frontal Impact Severity Index	26.36	17.11	-35.1
ADT	18000	19000	5.6
Fatal Crashes	2	3	50.0
Class A Injury Crashes	10	2	-80.0
Class B Injury Crashes	9	5	-44.4
Class C Injury Crashes	11	15	36.4
Non-Fatal Injury Crashes	30	22	-26.7

Crash Type Summary US 23/74 Section	Before	After	Percent Reduction (-)/ Percent Increase (+)
Angle	11	0	-100.0
Animal	1	0	-100.0
Backing Up	0	1	n/a
Fixed Object	1	12	1100.0
Left Turn, Different Roadways	15	2	-86.7
Left Turn, Same Roadway	1	2	100.0
Movable Object	1	1	0.0
Overturn/ Rollover	0	3	n/a
Parked Motor Vehicle	0	1	n/a
Pedestrian	1	0	-100.0
Ran Off Road - Left	1	0	-100.0
Ran Off Road - Right	7	0	-100.0
Rear End, Slow or Stop	5	14	180.0
Rear End, Turn	2	3	50.0
Right Turn, Different Roadways	0	3	n/a
Right Turn, Same Roadway	1	0	-100.0
Sideswipe, Opposite Direction	0	2	n/a
Sideswipe, Same Direction	4	6	50.0

Table 3. Locations 4, 5, and 8 Crash Summary

Location 4 Summary	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes	10	12	20.0
Total Severity Index	33.54	4.08	-87.8
Frontal Impact Crashes	7	2	-71.4
Frontal Impact Severity Index	35.60	4.70	-86.8
ADT	18300	19300	5.5
Fatal Crashes	0	0	n/a
Class A Injury Crashes	4	0	-100.0
Class B Injury Crashes	2	1	-50.0
Class C Injury Crashes	1	4	300.0
Non-Fatal Injury Crashes	7	5	-28.6

Location 5 Summary	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes	9	3	-66.7
Total Severity Index	21.96	3.47	-84.2
Frontal Impact Crashes	6	0	-100.0
Frontal Impact Severity Index	19.80	0.00	-100.0
ADT	18400	19600	6.5
Fatal Crashes	0	0	n/a
Class A Injury Crashes	2	0	-100.0
Class B Injury Crashes	2	0	-100.0
Class C Injury Crashes	3	1	-66.7
Non-Fatal Injury Crashes	7	1	-85.7

Location 8 Summary	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes	14	8	-42.9
Total Severity Index	26.36	22.73	-13.8
Frontal Impact Crashes	13	2	-84.6
Frontal Impact Severity Index	27.74	42.60	53.6
ADT	18500	19500	5.4
Fatal Crashes	2	1	-50.0
Class A Injury Crashes	2	1	-50.0
Class B Injury Crashes	2	0	-100.0
Class C Injury Crashes	5	3	-40.0
Non-Fatal Injury Crashes	9	4	-55.6

As shown in the previous tables, Locations 1-9 experienced an 8.6 percent overall decrease in Total Crashes. The US 23/ 74 Section experienced a 2.0 percent decrease in Total Crashes, a 46.9 percent decrease in the Total Severity Index, and a 75.0 percent decrease in Frontal Impact Crashes. In addition, Locations 4, 5, and 8 all experienced a substantial decrease in the number of Frontal Impact Crashes and a decrease in the Total Severity Index.

Results and Discussion

The naive before and after analysis of the US 23/ 74 Section (from MP 0.0 to 2.07) resulted in a 2.0 percent decrease in Total Crashes and a 75.0 percent decrease in Frontal Impact Crashes. There was also a decrease in the Total Severity Index (- 46.9%) and the Frontal Impact Severity Index (- 35.1%). The number of Fatal and Class A Injury Crashes decreased by more than 50 percent from twelve crashes in the before period to five crashes in the after period. The summary results above demonstrate that when using the naive before and after analysis method the treatment strip appears to have had a reduction in the frequency and severity of crashes from the before to the after period. Although the reduction in Total Crashes was minimal along the section, the number of Frontal Impact Crashes decreased significantly due to the directional crossovers.

Location 4 experienced a 20.0 percent increase in Total Crashes and a 71.4 percent decrease in Frontal Impact Crashes from the before to the after period. The crash severity decreased dramatically. The predominant crash pattern in the before period (Left-Turn, Different Roadway) was replaced by a majority of low severity Rear-End crashes in the after period. Please see the Before and After Collision Diagrams provided for Locations 4, 5, and 8.

Location 5 experienced a 66.7 percent decrease in Total Crashes and a 100.0 percent decrease in Frontal Impact Crashes from the before to the after period. As with Location 4, the crash severity decreased dramatically. The number of injury crashes decreased from seven crashes in the before period to one crash in the after period. In addition to restricting side-street movements, the channelization at this location also prohibits left-turns for eastbound US 23/ 74 traffic.

Location 8 experienced a 42.9 percent decrease in Total Crashes and an 84.6 percent decrease in Frontal Impact Crashes from the before to the after period. The Frontal Impact Severity Index increased by 53.6 percent, which is attributed to a fatal injury crash in the after period. The fatal crash involved a westbound travelling motorist making a left-turn movement in front of an eastbound motorist. One Rear-End crash also resulted in a class A injury in the after period. The directional crossover did correct the predominant Left-Turn, Different Roadway crash trend that resulted in two fatal injury crashes in the before period.

The raised islands constructed in the Locations 4, 5, 7, and 8 restrict movements for both side street approaches. Motorists wishing to make these movements need to find an alternative route (i.e. potential crash migration occurs). Therefore, the effect of the Treatment Locations on the surrounding median crossovers and on US 23/ 74 as a system must remain in consideration while assessing the analysis of the Treatment Locations. In particular, U-turn crashes had the potential to increase in the after period because of the movements prohibited at the treatment location.

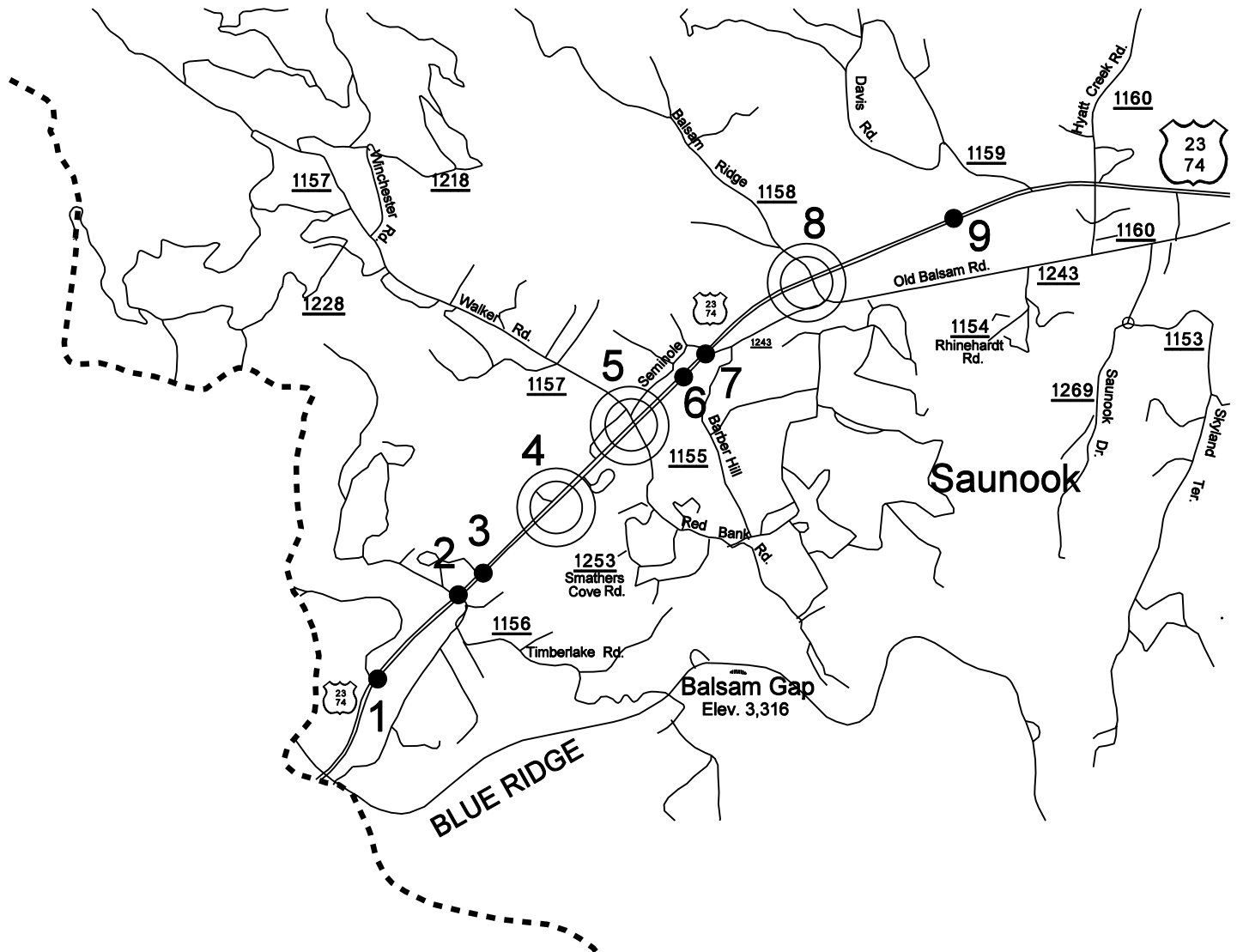
As previously stated, Locations 6 and 9 were constructed as part of the project improvement, to allow left and thru-traffic to U-turn back to their desired direction. Note that bulb-outs are provided to aid motorists in their U-turning movement. A combined total of two crashes occurred at Locations 6 and 9 in the after period. It appears that the treatment intersection has had minimal impact on the number of crashes at these two U-turn locations. The other non-treatment intersections within the strip also appear to have had a minimal change in the number of crashes from the before to the after period. Overall, Locations 1 through 9 experienced an 8.6 percent decrease in crashes after the spot safety treatments were installed. Please see the attached *Treatment Site Location Photos*. Photos are provided for Locations 3 through 9.

The countermeasure crash reduction for Total Crashes and for Frontal Impact Crashes at Location 4 is a 20.0 percent increase and a 71.4 percent decrease in crashes. The countermeasure crash reduction for Total Crashes and for Frontal Impact Crashes at Location 5 is a 66.7 percent decrease and a 100.0 percent decrease in crashes. The countermeasure crash reduction for Total Crashes and for Frontal Impact Crashes at Location 8 is a 42.9 percent decrease and an 84.6 percent decrease in crashes. As the Safety Evaluation Group completes additional spot safety reviews for this type of countermeasure, we will be able to provide objective and definite information regarding actual crash reduction factors.

Location Map

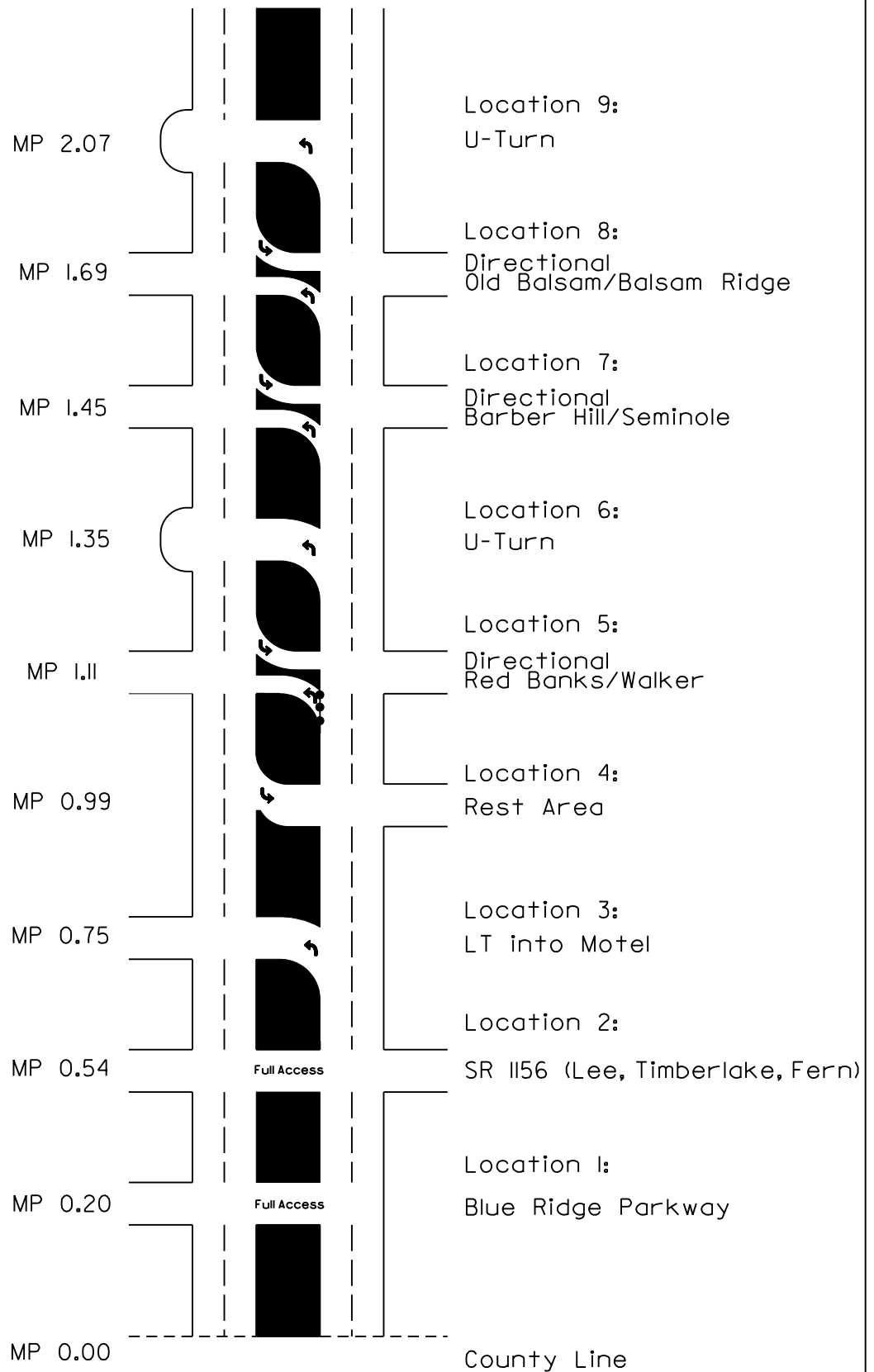
Spot Safety Project #14-97-018

Haywood County



Median Crossovers 1-9 Located on US 23-74 from MP 0.0 to MP 2.07

US 23/74 from Jackson County Line Northeast to Crossover 9 (2.07 mi)



Treatment Site Photos (Taken on July 28, 2005)



Driving northeast at Location 3



Driving northeast at Location 4

Treatment Site Photos (Taken on July 28, 2005)



Driving northeast at Location 5



Driving northeast at Location 6



Driving northeast at Location 7

Treatment Site Photos (Taken on July 28, 2005)

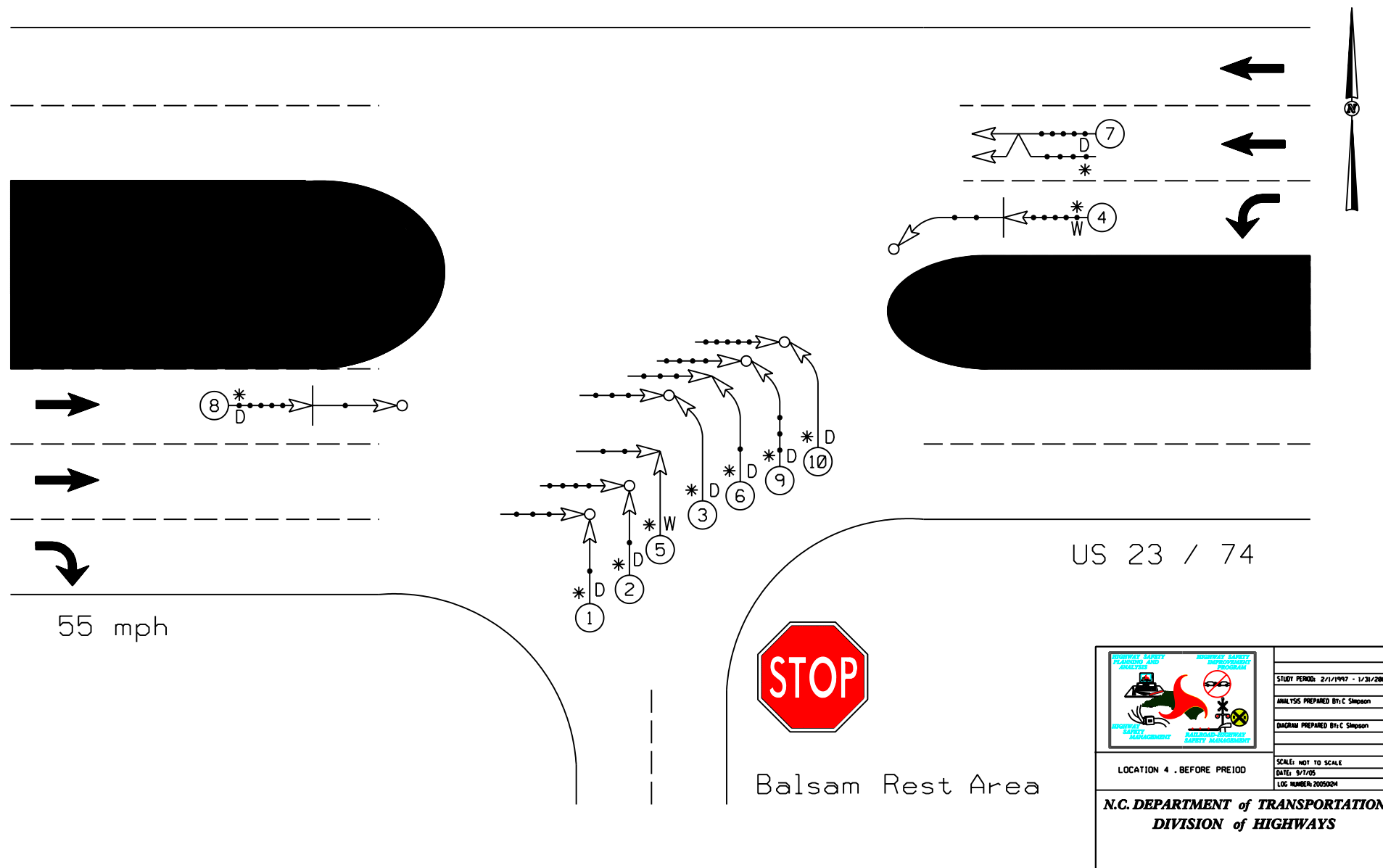
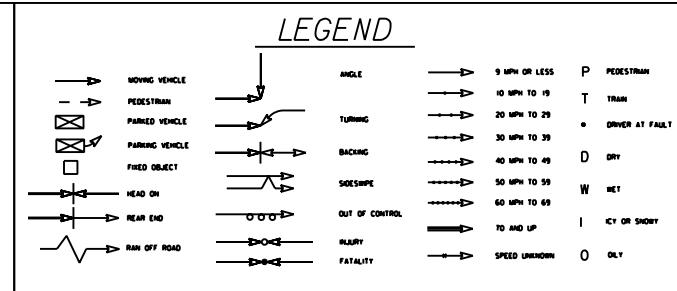


Driving northeast at Location 8

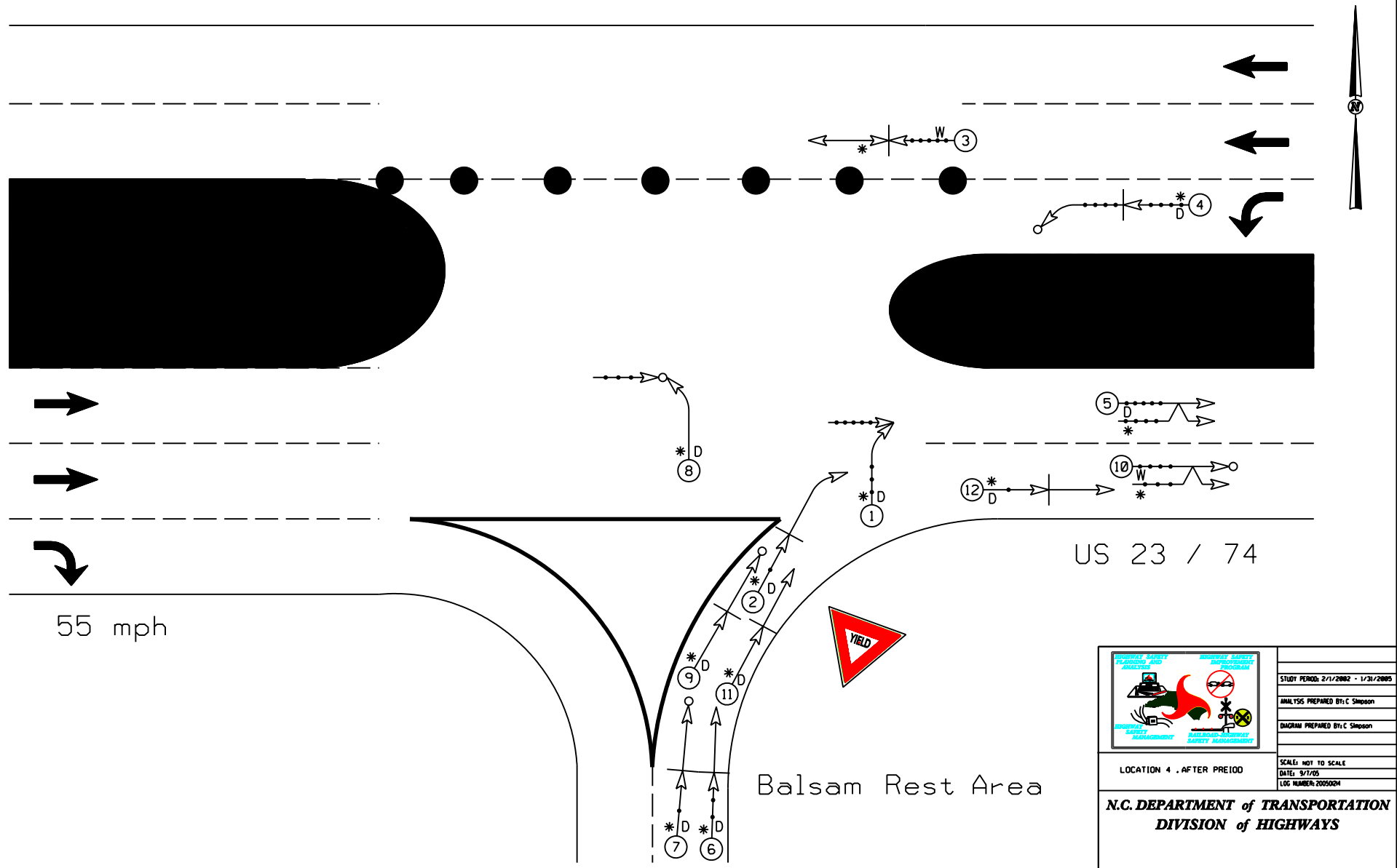
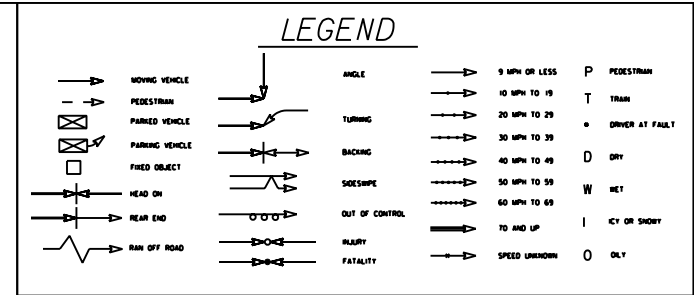


Driving northeast at Location 9

Location 4. US 23 / 74 at Balsam Rest Area
Haywood County
February 1, 1997 - January 31, 2000
Before Period - Total Crashes



Location 4. US 23 / 74 at Balsam Rest Area
Haywood County
February 1, 2002 - January 31, 2005
After Period - Total Crashes

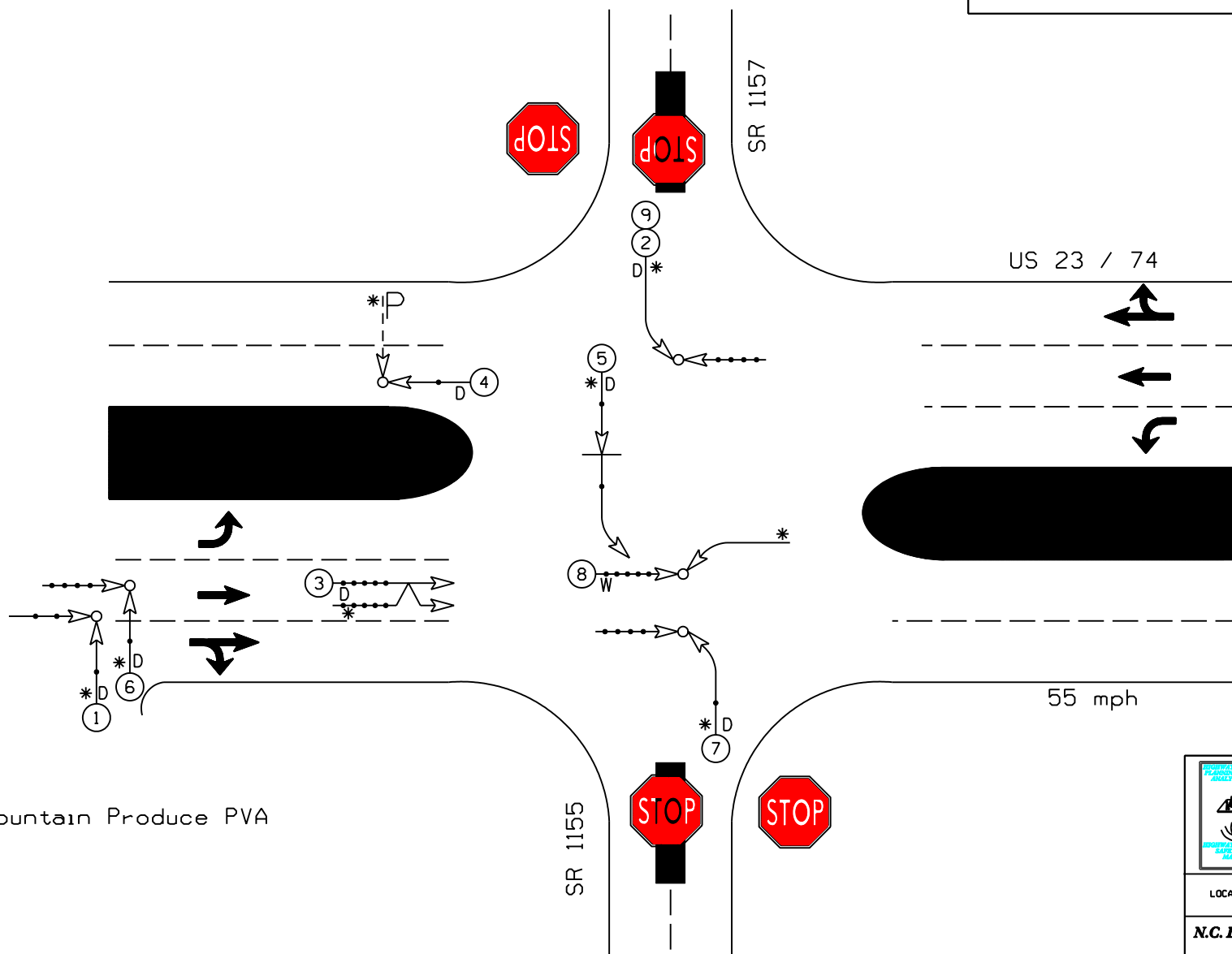


LOCATION 4 . AFTER PREIOD

































N.C. DEPARTMENT of TRANSPORTATION
DIVISION of HIGHWAYS

STUDY PERIOD: 2/1/2002 - 1/31/2005
ANALYSIS PREPARED BY: C Simpson
DIAGRAM PREPARED BY: C Simpson
SCALE: NOT TO SCALE
DATE: 9/1/05
LOG NUMBER: 20050204

Location 5. US 23 / 74 at SR 1157 / SR 1155
Haywood County
February 1, 1997 - January 31, 2000
Before Period - Total Crashes



LEGEND

	MOVING VEHICLE		ANGLE		9 MPH OR LESS		PEDESTRIAN
	PEDESTRIAN		TURNING		10 MPH TO 19		TRAIN
	PAVED VEHICLE				20 MPH TO 29		DRIVER AT FAULT
	PARKING VEHICLE		BACKING		30 MPH TO 39		WET
	FIXED OBJECT		SLOPE		40 MPH TO 49		ICY OR SNOWY
	HEAD ON		OUT OF CONTROL		50 MPH TO 59		ONLY
	REAR END				60 MPH TO 69		
	RAN OFF ROAD		HAZARD		70 AND UP		
			FATALITY		SPEED UNKNOWN		



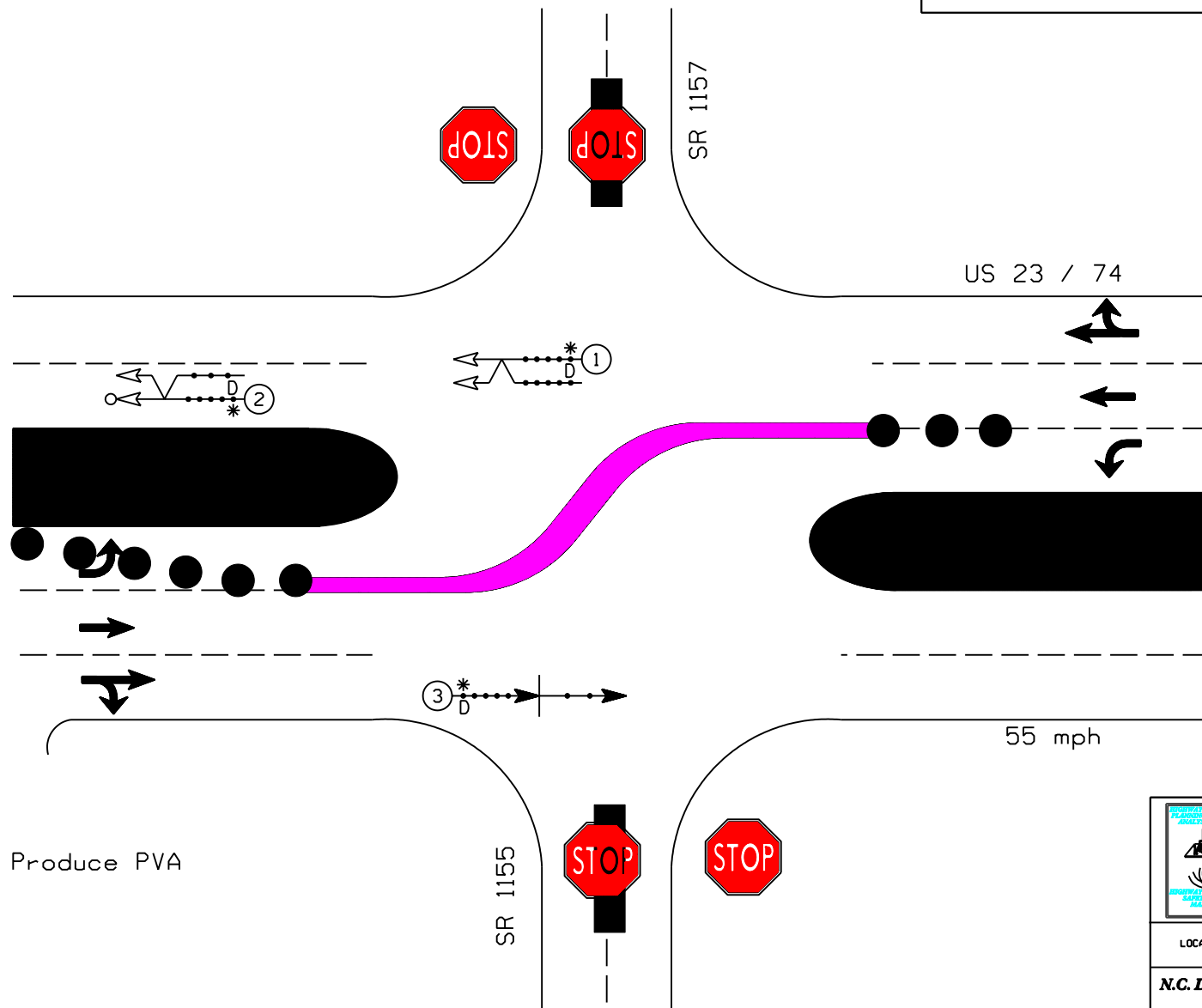
The diagram illustrates the four main components of the National Highway Traffic Safety Administration's (NHTSA) safety programs, arranged around a central graphic of a car crash. The components are:

- Highway Safety Planning and Analysis** (top left): Represented by a computer monitor showing a road scene.
- Highway Safety Improvement Program** (top right): Represented by a red circle with a diagonal line through it, indicating a prohibition or restriction.
- Highway Safety Management** (bottom left): Represented by a car with a driver, with a red flame indicating a crash.
- Railroad-Highway Safety Management** (bottom right): Represented by a train crossing, with a yellow circle with a black 'X' indicating a hazard or danger.






































STUDY PERIOD: 2/1/1997 - 1/31/2000
ANALYSIS PREPARED BY: C Simpson
DIAGRAM PREPARED BY: C Simpson
SCALE: NOT TO SCALE
DATE: 9/7/05
LOG NUMBER: 20050204

N.C. DEPARTMENT of TRANSPORTATION DIVISION of HIGHWAYS

Location 5. US 23 / 74 at SR 1157 / SR 1155
Haywood County
February 1, 2002 - January 31, 2005
After Period - Total Crashes



LEGEND

	MOVING VEHICLE		ANGLE		9 MPH OR LESS		PEDESTRIAN
	PEDESTRIAN				10 MPH TO 19		TRAIN
	PARKED VEHICLE		TURNING		20 MPH TO 29		DRIVER AT FAULT
	PARKING VEHICLE				30 MPH TO 39		D
	FIXED OBJECT		BACKING		40 MPH TO 49		D
			SIDESWipe		50 MPH TO 59		W
	HEAD ON		OUT OF CONTROL		60 MPH TO 69		I
	REAR END				70 AND UP		ICY OR SNOWY
	RAN OFF ROAD		INJURY		SPEED UNKNOWN		O
			FATALITY				



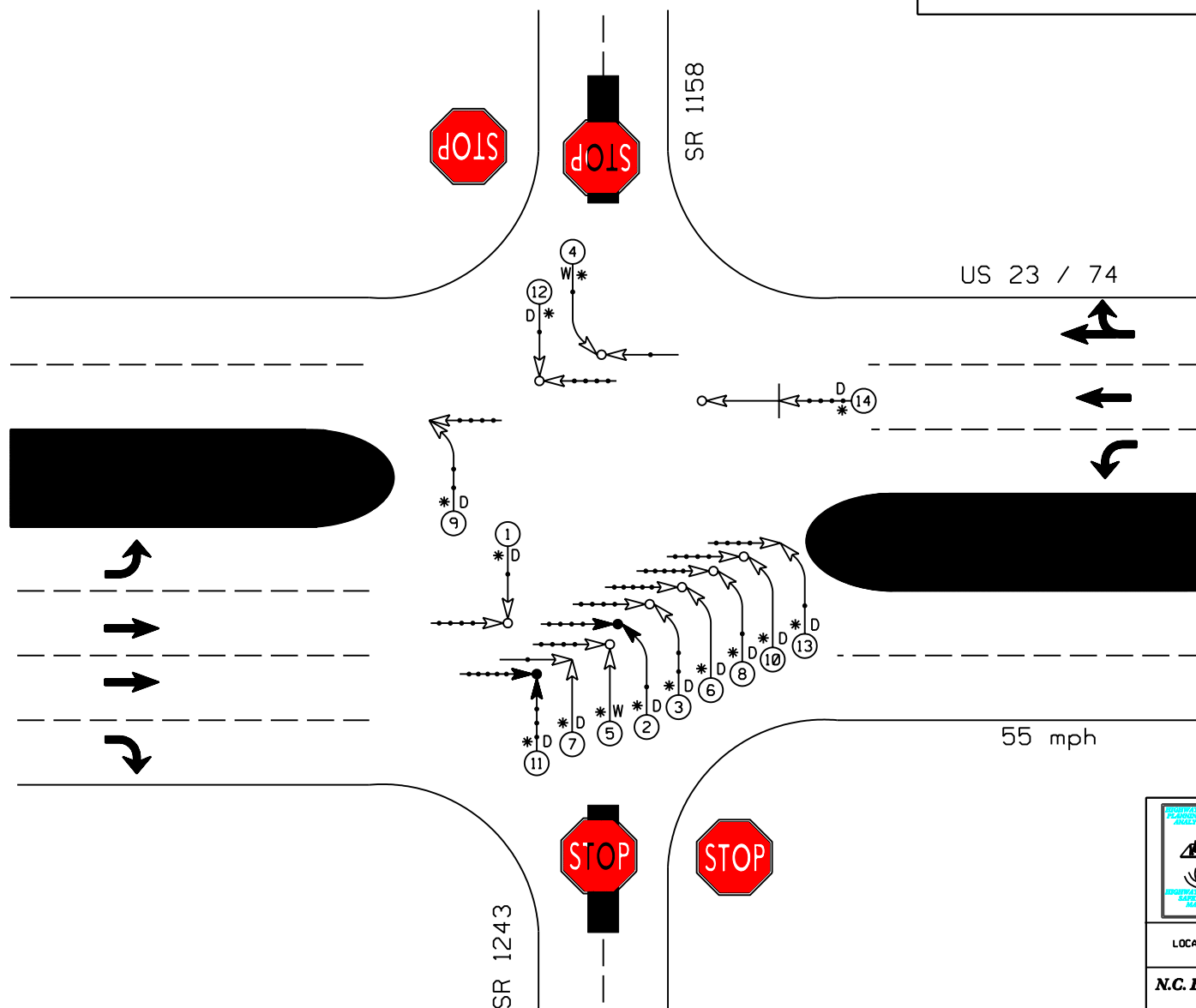
Mountain Produce PVA



































LOCATION 5 . AFTER PERIOD

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DIVISION of HIGHWAYS**


Location 8. US 23 / 74 at SR 1158 / SR 1243
Haywood County
February 1, 1997 - January 31, 2000
Before Period - Total Crashes





























LEGEND

	MOVING VEHICLE		ANGLE		9 MPH OR LESS		PEDESTRIAN
	PEDESTRIAN		TURNING		10 MPH TO 19		TRAIN
	PAVED VEHICLE				20 MPH TO 29		DRIVER AT FAULT
	PARKING VEHICLE		BACKING		30 MPH TO 39		WET
	FIXED OBJECT		SLOPE		40 MPH TO 49		ICY OR SNOWY
	HEAD ON		OUT OF CONTROL		50 MPH TO 59		ONLY
	REAR END		HAZARD		60 MPH TO 69		
	RAN OFF ROAD		FATALITY		70 AND UP		
					SPEED UNKNOWN		



 <p>The diagram is enclosed in a blue border. At the top left, it says 'ROADWAY SAFETY PLANNING AND ANALYSIS'. At the top right, it says 'ROADWAY SAFETY IMPROVEMENT PROGRAM'. In the center, there is a large red flame-like shape. To the left of the flame is a computer monitor on a stand with a red prohibition sign over it. To the right of the flame is a traffic light pole with a red prohibition sign over it. Below the flame, there are two labels: 'ROADWAY SAFETY MANAGEMENT' on the left and 'BASELINE-ROADWAY SAFETY MANAGEMENT' on the right. Arrows point from these labels towards the central flame area.</p>	<table border="1"> <tr> <td>STUDY PERIOD: 2/1/1997 - 1/31/2000</td> </tr> <tr> <td>ANALYSIS PREPARED BY: C Simpson</td> </tr> <tr> <td>DIAGRAM PREPARED BY: C Simpson</td> </tr> <tr> <td>SCALE: NOT TO SCALE</td> </tr> <tr> <td>DATE: 9/7/05</td> </tr> <tr> <td>LOG NUMBER: 2005004</td> </tr> </table>	STUDY PERIOD: 2/1/1997 - 1/31/2000	ANALYSIS PREPARED BY: C Simpson	DIAGRAM PREPARED BY: C Simpson	SCALE: NOT TO SCALE	DATE: 9/7/05	LOG NUMBER: 2005004
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SCALE: NOT TO SCALE							
DATE: 9/7/05							
LOG NUMBER: 2005004							
<p>LOCATION 8 . BEFORE PREIOD</p>							
<p><i>N.C. DEPARTMENT of TRANSPORTATION</i> <i>DIVISION of HIGHWAYS</i></p>							

LEGEND

	MOVING VEHICLE		ANGLE		9 MPH OR LESS	P	PEDESTRIAN
	PEDESTRIAN				10 MPH TO 19	T	TRAIN
	PAUSED VEHICLE		TURNING		20 MPH TO 29		
	PARKING VEHICLE				30 MPH TO 39	D	DRIVER AT FAULT
	FIXED OBJECT		BACKING		40 MPH TO 49	D	DRY
	HEAD ON		SIDE-SWipe		50 MPH TO 59	W	WET
	REAR END		OUT OF CONTROL		60 MPH TO 69	I	ICY OR SHOOTY
	RAN OFF ROAD		HAZARD		70 AND UP	O	ONLY
			FATALITY		VELOCITY UNKNOWN		

